USER MANUAL

- ☑ **-75V to +75V output**
- ☑ **DC to 20kHz at -3dB full power bandwidth**
- ☑ **single power supply 18V – 30V DC, battery power possible**
- ☑ **50kΩ output impedance**
- ☑ **Stable with all capacitive loads, generates no overshoot**
- ☑ **Short-circuit protected output**
- ☑ **For MEMS devices, EO-modulators, PZT (piezo) positioning, beam steering, ultrasonics, …**

About this manual

This user manual is an integral part of the Falco Systems WMA-005 amplifier product. Please read it carefully and pay attention to the recommendations and the instructions for safe use.

General description

The Falco Systems WMA-005 is a high voltage amplifier that runs from an 18 – 30V DC power supply and can be battery powered if required, e.g. for use in a Faraday cage. Its internal high voltage generator is inductor-free and hence does not spread magnetic interference in sensitive experimental setups. Its large voltage range makes it an excellent choice for use with MEMS devices, EO-modulators, PZT (piezo) positioning systems, beam steering components, and many more.
The amplifiers' full-power frequency response has a -3dB corner frequency at 20kHz. The input impedance is 100kΩ and the output 50kΩ.

The output noise is at this price level impressively low at 3mVrms. For extremely low noise applications where bandwidth is not an issue, a dedicated WMA-005LF version is available that contains an output low pass filter capacitor which reduces the bandwidth to 50Hz, but makes the noise drop to 0.1mVrms. This bandwidth-limited amplifier is ideal for MEMS or piezo positioning with manual voltage adjustment requiring extremely low noise.

The WMA-005 contains an over-voltage protection for the daily use and abuse in the laboratory and is long-term short-circuit proof. The input (indicated "Input" on the WMA-005 label), output (indicated "Output") and DC power supply (Indicated "18 – 30V DC 120mA") connections are all standard BNC.

The amplification is 20x (fixed). With a range of –75V to +75V, a –3dB bandwidth of 20kHz, possibility for battery powered operation, and below 3mVrms output noise, this amplifier will enable many measurements in different applications.

Safety

- This product is able to produce over 75V, but the 50kΩ output impedance limits the current to a rather safe maximum of 1.5mA. Although this voltage is painful it will under normal circumstances not be lethal. Nevertheless take care. This is a high voltage unit and safety measures should be taken accordingly.
- The internal circuitry of the amplifier operates at high voltage. Only qualified personnel from Falco Systems should service this amplifier.
- When the amplifier is turned on or off, a short voltage spike may appear at the output which may damage circuitry already connected to it.
- Replace the fuse with 250V 315mAT 5x20mm rated fuses only.
- The Falco Systems WMA-005 is only suitable for indoor use in a class

II environment (domestic, light industrial).
- The power supply connected to the WMA-005 should be double insulated (class II) or a SELV type (SELV = Safety Extra Low Voltage, typically a battery).
- The WMA-005 is a class III product. Do not connect the amplifier to the mains safety earth. If this is done, the system becomes a class I apparatus with class III isolation, which means that the protective insulation may be inadequate. Doing so (only under laboratory conditions) is fully at the users' risk. Risk of electric shock!
- The WMA-005 should not be used above 1500m altitude to prevent electrical breakdown.
- This product should only be cleaned with a soft, slightly moist cloth. Unplug the WMA-005 from the DC power before cleaning.

Input protection

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A low-noise amplifier like the WMA- -
005 can never be made fully insensitive to input overload conditions, as this would limit the performance of the amplifier to an unacceptably low level. The maximum input voltage is 10V, and the absolute maximum rating is 15V. Warning: exceeding this spec may cause permanent malfunction of the amplifier and is not covered by the warranty!
For normal operation, input voltages should remain in the –3.75V to +3.75V range, resulting with an amplification of 20x in an output voltage swing of more than –75V to +75V.

Never apply more than +10V (-10V) to the amplifier input!

Output protection

The WMA-005 has been designed to be fully stable with all capacitive loads. It has been optimized for its step-response, but is also a very good linear and sine-wave amplifier. No significant overshoot occurs at any capacitive load.
Overloading or short-circuiting this amplifier will not break down the amplifier, due to the 50kΩ current limiting resistor that has been employed at the output.

Although the amplifier cannot be damaged by a short-circuit condition or capacitive loading, two situations should be avoided:
Connecting a charged capacitor
Using high inductance values (coils)

The load

The output impedance of the WMA-005 is 50kΩ. The amplifier is generally used for high-impedance applications where the load is mainly capacitive. This is true for MEMS devices, EO-modulators and PZT's (piezo's) alike. It should be noted that a coaxial cable also presents a capacitive load of approximately

100pF/m. The cables that are connected may well limit the maximum usable frequency.
If output monitoring is required, it is recommended to connect a 10x oscilloscope probe to the output. A special BNC to probe tip connector is usually supplied with the probe (Fig. 1). However, the user can choose a different way of connecting the oscilloscope, as long as care is taken with the high output voltage. Pieces of non-coaxial cable in the connection can cause overshoot in the oscilloscope reading.

Figure 1. The 10x probe connected for monitoring the output signal

The amplifier is capable of amplifying above 9kHz, and should not be used for telecommunication as described in the R&TTE directive 95/5/EC. To prevent unwanted radiation all leads should be kept shorter than 30m.

Noise

The WMA-005 is a low noise amplifier. The output noise is typically below 3mVrms. If this is not good enough, a dedicated version called the WMA-005LF is available that provides less than 0.1mVrms noise: however, the bandwidth is then limited to DC – 50Hz (-3dB) instead of DC – 20kHz (-3dB).

Amplifier characteristics

In the following pages, several amplifier characteristics are shown:
- Frequency response (Fig. 2, 3)
- Square wave response (Fig. 4, 5, 6)
- Capacitive load dependency of square wave output (Fig. 7)
- Triangle and sine response (Fig. 8, 9)
- Noise and offset (Fig. 10, 11)

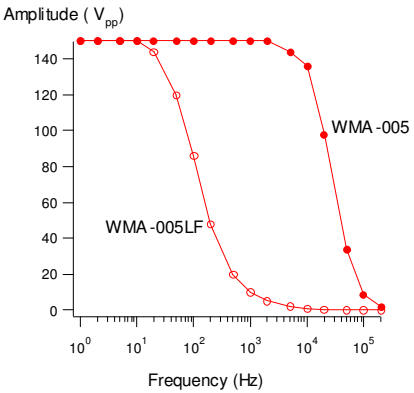

Figure 2. Frequency response at 150V_{pp} output voltage

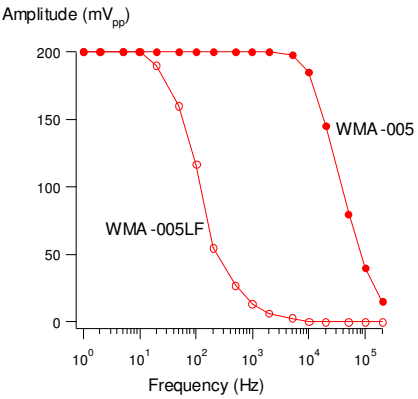

Figure 3. Frequency response at 200mV_{pp} output voltage

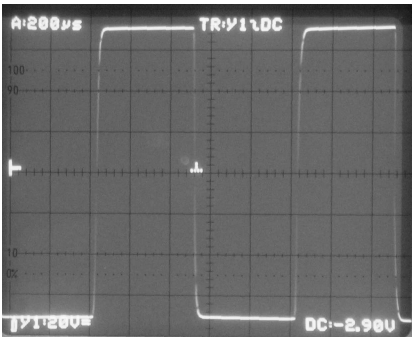

Figure 4. 150V_{pp} 1kHz square wave

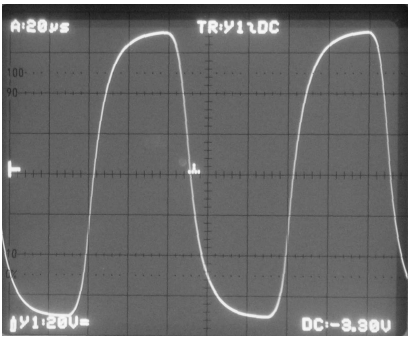

Figure 5. Full scale 10kHz square wave

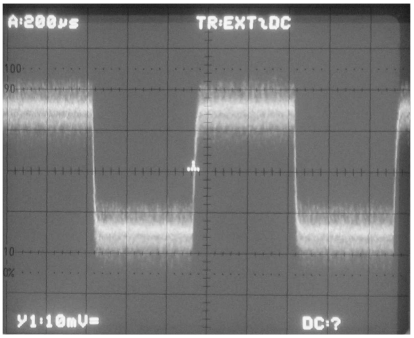

Figure 6. 30mV_{pp} 1kHz small square wave output signal

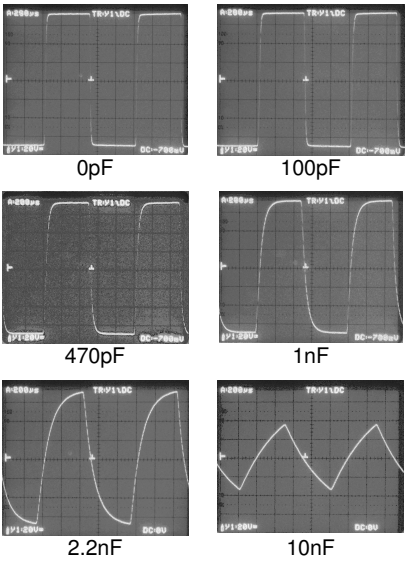

Figure 7. Full-power 1kHz square wave response with different capacitive loading conditions. The 50kΩ output resistor limits the speed at which the capacitor can be charged.

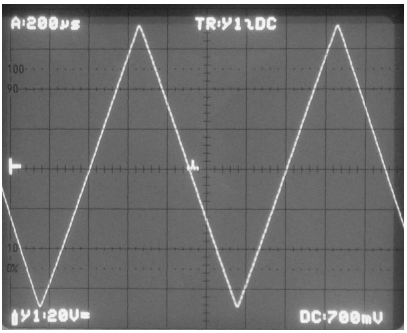

Figure 8. Triangle wave $150V_{pp}$ 1kHz

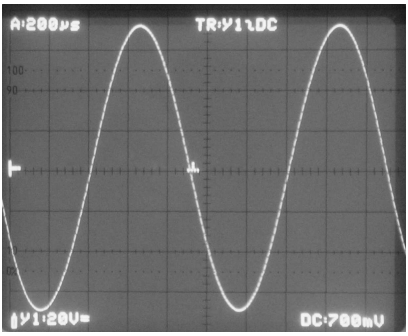

Figure 9. Sine wave $150V_{pp}$ 1kHz

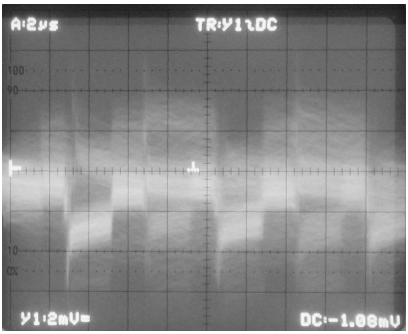

Figure 10. Noise (less than 10mV peak-peak or, equivalently, 3mVrms) and typical offset (-1.1mV) for the WMA-005. The high voltage generator frequency (around 150kHz) contributes considerable to the overall noise. Loading with 1m of coaxial cable.

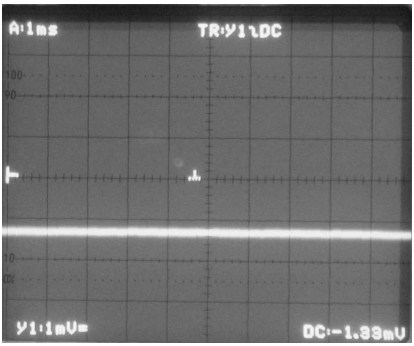

Figure 11. Noise (about 0.2mV peak-peak or, equivalently, less than 0.1mV rms) and typical offset -1.3mV) for the WMA-005LF. The offset may change (becomes less) with the impedance of the driving voltage source at the input of the WMA-005.

Technical specifications

Amplification: 20x, fixed

Bandwidth: DC – 20kHz @ -3dB for WMA-005

Bandwidth: DC – 50Hz @ -3dB for WMA-005LF

Power supply: single 18 – 30V DC, 120mA max, can be battery powered

Output voltage: -75V to +75V

Noise: 3mVrms noise over the full bandwidth typical for the WMA-005, -1.1mV offset typical

Noise: <0.1mV rms noise over the full bandwidth typical for the WMA-005LF, -1.3mV offset typical

Input impedance: 100kΩ

Output impedance: 50kΩ

Stability: stable with all capacitive and resistive loads, generates no overshoot

Fuse: 1x 315mAT 230V

Operating temperature: 5 – 50°C

Storage temperature: 0 – 60°C

Relative humidity: 10 – 90% non-condensing

Dimensions: 50 x 100 x 26 mm excl. BNC's

Weight: 300g

Warranty: 1 year

Country of origin: The Netherlands

Specifications are subject to change

Warranty

Falco Systems products are guaranteed against malfunction due to defects in materials or workmanship for a period of 1 year from the date of shipment.
If such a malfunction occurs during this period, the product will be repaired or replaced (at our option)

without charge. The product will be returned to the customer prepaid.
The warranty does not apply to:
- Exterior finish or appearance
- Malfunction resulting from use or operation of the product other than as specified in the user manual
- Malfunctioning due to misuse or abuse of the product
- Malfunctioning occurring any time after changes or repairs have been made to the product by anyone other than Falco Systems.

To obtain warranty service, the customer must inform Falco Systems first, and then send the product, prepaid, to Falco Systems together with a proof of purchase of the product in the form of a bill of sale or receipted invoice.

This warranty explicitly only covers the product itself. The repair or replacement including return to the customer are the only services provided to the customer in this respect. Falco Systems will not be liable for any consequential damages, including, without limitation, devices or equipment connected to the product, injury to persons or property or loss of use. See for more details the Falco Systems Standard Terms and Conditions of Sale.

User manual version

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Harmonized standards

This product complies with the following harmonized European standards:

EMC: EN61326
Safety: EN61010

CE

WEEE

Do not dispose of the WMA-02 and WMA-02LF as standard waste, but bring them to a WEEE electronic waste collection point.

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